

8/PRTS

09/831289
JC08 Rec'd PCT/PTO 07 MAY 2001

Description

Drive assembly for a hair clipping machine.

Background of the invention

The invention relates to a drive assembly for a hair clipping machine according to the preamble of claim 1.

Such drive assemblies are generally known in the art. These drive assemblies include an electrical drive motor which consists of a field magnet with a coil and a core penetrating the coil, as well as an armature. The armature begins to oscillate when the field magnet is excited and can move a clipping assembly of a hair clipping machine via a drive pin arranged on one end of the armature

Conventional drive assemblies have an armature which is arranged essentially parallel to the assembly consisting of the field magnet and the coil, so that (as viewed from above) the air gap between the armature and the assembly consisting of the field magnet and coil is straight.

A disadvantage of this construction is that the magnetic flux is not optimized.

EP 0 802 614 A1 therefore proposes to optimize the air gap by offsetting the field magnet and the armature in the regions forming the air gap sections in a step-like pattern. This applies, on one hand, to the center region of the armature which is provided with a recess in which a matching protrusion of the core engages without making contact. On the other hand, the air gap sections located to the side on the periphery of the coil also have a step-like pattern, so that the field magnet and the armature can engage with each other. A modification of this embodiment (figure 8) shows lateral air gap sections, with one of the sections having a straight inclined shape, whereas the other lateral air gap section has a triangular shape which is offset sideways.

Air gap geometries of this type can increase the efficiency by improving the magnetic flux. The disadvantage, however, is that the field magnet and the armature have to be associated relative to each other very accurately to maintain an optimal magnetic flux. Relatively small lateral deviations, which cannot be avoided in practical situations, can already significantly lower the forces that can be generated, so that the theoretical design values are rarely achieved. As a result, the manufacture is very expensive since the field magnet and the armature have to be positioned with great accuracy in the housing of the hair clipping machine.

A similar problem is encountered with the oscillating armature motor disclosed in DE-AS **?(number illegible) 282 155**, wherein a staircase-shaped air gap geometry with a plurality of steps is formed.

The present invention therefore intends to solve the problem by improving a drive assembly for a hair clipping machine of the aforescribed type, so that the aforescribed disadvantages are eliminated. In particular, the improvement of the drive assembly should include a simplified construction and consequently lower manufacturing costs and also provide an optimized magnetic flux.

This problem is solved by a drive assembly for a hair clipping machine having the characterizing features of claim 1. Advantageous embodiments are disclosed in the features of the dependent claims.

The invention is based on the concept of forming the center air gap sections as well as the lateral air gap sections approximately symmetrical and inclined relative to the longitudinal axis. The symmetric arrangement ensures that the resulting forces remain constant independent of a possible lateral displacement. As a result, these forces are substantially independent of dimensional tolerances and manufacturing variations.

The inclined orientation of the air gaps relative to the longitudinal axis provides that the magnetic path is smaller than the mechanical separation.

This results in the following advantages and possible additional modifications:

- optimized drive power for a defined geometry and electrical power, or
- reduced complexity (less windings) for the copper coil at the original power, or
- larger manufacturing tolerances at the original power, or
- increased power using the original design.

The reason for the above is that an increased efficiency is attained with the same geometry.

It is particularly advantageous if the inclination of the air gap with respect to the longitudinal axis is approximately 45° , since thereby the magnetic path is smaller than the mechanical separation by a factor $1/\sqrt{2}$, thereby significantly increasing the efficiency.

Optimized air gap sections for the center section can be manufactured easily by providing the armature in the region of the longitudinal axis with triangular notches, wherein a corresponding shaped center rib of the core projects into these notches without making contact thereto.

Alternatively, the air gap sections may also have a curved contour instead of the straight contour.

The devices can be manufactured more easily if the air gap sections are formed to be straight when viewed in longitudinal cross-section. The field magnets and armatures

which are frequently constructed from stacks of sheet metal, can be shaped by a simple stamping operation. To optimize the efficiency, it is advantageous to provide an inclined or offset cross section also in the longitudinal direction, i.e., in the direction of the height of the device. Suitable manufacturing tools therefor are available, although this design is more complex than the design of air gap sections which are straight in the height direction.

The magnetic flux can be optimized if the air gap section encloses an angle of approximately 45° also in the height direction.

The drive assembly can advantageously be formed as a single module, if the armature is connected to the end of the field magnet opposite to the drive pin. This can be achieved, for example, by using clips, plates, or bolt arrangements.

To support the oscillation of the armature, at least one compression spring is arranged between the armature and the field magnet.

According to another advantageous embodiment, the resonance frequency of the drive can be adjusted by adjusting the spring excursion of the compression spring through an adjusting screw or a clamp which lockingly engages the legs of the clip.

Brief Description of Drawings

The invention will be described hereinafter with reference to the embodiments illustrated in the drawings. It is shown in:

Figure 1: A top view of a first embodiment, wherein the assembly formed of the field magnet and the coil are implemented separate from the armature.

Figure 2: A top view of a second embodiment, wherein the field magnet-coil-assembly is connected to the armature through a first clip;

Figure 4: A top view of a third embodiment, wherein the field magnet-coil-assembly is connected to the armature through the first plate;

Figure 4: A top view of a fourth embodiment, wherein the field magnet-coil-assembly is connected to the armature via a second plate;

Figure 5: A top view of a fifth embodiment, wherein the armature oscillates parallel to the field magnet-coil-assembly;

Figure 6: A top view of a sixth embodiment, wherein the field magnet-coil-assembly is connected to the armature via a second clip;

Figure 7: A top view of a seventh embodiment, wherein the field magnet-coil-assembly is connected to the armature via a third clip; and

Figure 8: A top view of an eighth embodiment having a modified air gap section.

Description of Preferred Embodiment

In the following detailed description of the figures, identical parts have identical reference numerals.

The basic construction of a drive assembly 10 for a hair clipping machine is illustrated in figure 1. The drive assembly 10 consists of an electric drive motor 12 which has a horseshoe-shaped field magnet 14 with a core 28 (as viewed from the top), with a coil 16 arranged within the core 28.

An armature 18, which in this case is formed as a separate element or module, is arranged proximate to the ends of the legs of the field magnet 14. The drive motor 12 in this case is also formed as a module, so that both modules can be easily exchanged.

To optimize the magnetic flux, the air gap between the field magnet 14 and the armature 18 has a special geometry. The air gap sections a, b between the field magnet 14 - in the region of the core 28 - and the armature 18 - adjacent to a longitudinal axis 24 of the coil 16 - are essentially inclined relative to the longitudinal axis 24. This is attained, on one hand, by triangular notches 26 arranged in the armature 18 in the region of the longitudinal axis 28, with a center rib 27 of the core 28 projecting into the notches 26 without making contact thereto.

The slope of the air gap, on the other hand, continues between the corresponding ends of the field magnet 14 and the armature 18 in the region of the notches 26 on the side of the coil 16. In this region, air gap sections A, B are formed.

The slope of the air gap sections, A, a, b, B, i.e., the angle relative to the longitudinal axis 24, is approximately 45° , since the magnetic path is thereby smaller than the mechanical separation by a factor $1/\sqrt{2}$. This arrangement may advantageously improve the manufacturing tolerances which then no longer have to match the severe requirements of conventional drive assemblies. In addition, the center air gap sections a, b and lateral air gap sections A, B are arranged approximately symmetrical with respect to the longitudinal axis 24. Displacement transverse to the longitudinal axis 24, as may occur during manufacture and/or installation, does not cause deviations in the generated forces.

The basic construction and shape of the air gap described with reference to figure 1 is identical for all embodiments.

As already mentioned above, the embodiment of figure 1 includes two modules, wherein one end of the armature 18 includes a drive pin 20 which can set a clipping assembly of a hair clipping machine in motion. A bearing 22 which is connected to an oscillating spring 44 is attached on the end of the armature 18 opposite to the drive pin 20. The oscillating spring 44 is held by two bolts 44 attached to the housing.

The embodiments of figures 2-8 and the aforescribed shape of the air gap both have drive assemblies 10 described therein that are formed as a single module.

This is achieved in all the embodiments of figures 2-8 by a linkage which is arranged at the end of the armature 18 opposite the drive pin 20 and connects the field magnet 14 with the armature 18. In the embodiment shown in figure 2, the linkage has the form of a clip 30 having a U-shape.

A compression spring 38 is arranged adjacent to the leg ends of the U-shaped clip 30, wherein the spring travel of the compression spring can be adjusted via an adjusting screw 40 to adjust the resonance frequency.

The third embodiment illustrated in figure 3 is different from the embodiment of figure 2 in that the field magnet 14 is connected to the armature 18 via a first plate 32, wherein the armature 18 is pivotally supported on a pin 44 secured to the plate 32.

The third embodiment also includes the compression spring 38, wherein the spring travel for adjusting the resonance frequency can be adjusted with the adjusting screw 40.

The fourth embodiment illustrated in figure 4 includes as a linkage between the field magnet 14 and the armature 18 a second plate 32a which also has a pin 44. Unlike the third embodiment illustrated in figure 3, the end of the armature 18 opposite to the drive pin 20 does not completely surround the pin 44, since this end is formed as a sleeve which is not completely enclosed.

The arrangement of the compression spring 38 with the adjusting screw 40 is similar to the embodiment of figure 3.

A fifth embodiment is illustrated in figure 5 which enables a parallel oscillation between the armature 18 and the field magnet 14.

This is achieved by connecting the assembly consisting of the field magnet 14 and the coil to the armature 18 with two bolt arrangements 36.

These bolt arrangements 36 consist of the aforescribed compression springs 38 with adjusting screws 40 which in this case are arranged on the respective ends of the field magnet 14 and the armature 18.

This arrangement improves the association between the field magnet 14 and the armature 18 and also provides more stable oscillation characteristics.

Due to the parallel drive, a clipping knife moved by the drive pin 20 no longer follows a circular path, so that angles are no longer required.

In the sixth embodiment illustrated in figure 6, the field magnet 14 and the armature 18 are connected to each other via a second clip 30a.

The compression spring 38 with the corresponding adjusting screw 40 is once again secured in the region between the clip 30a and the leg of the field magnet 14 adjacent to the coil 16.

A seventh embodiment similar to the modification illustrated with reference to figure 2 is shown in figure 7, with the field magnet 14 in this case also connected to the armature 18 via a third clip 30b.

A compression spring 38 is here also arranged on the ends of the leg of the approximately U-shaped clip 30b.

In this seventh embodiment, the resonance frequency can be adjusted by placing a lockable clamp 32 on the clip 30b starting from the curved end of the clip 30b. Different

insertion depths of the clamp cause different spacings between the legs of the clip 30b, so that the spring travel of the compression spring 38 can be affected.

All embodiments are implemented as assemblies that can be easily mounted and have, with the exception of the first embodiment of figure 1, compression springs that are independent of the housing. All embodiments have more stable oscillation characteristics with the design of the air gaps providing an approximately optimized magnetic flux.

The modification according to figure 8 has an additional feature. The basic construction is the same as that of figure 2, wherein the air gap, however, is further optimized. The air gap sections A, a, b, B do not extend perpendicularly and straight through in the longitudinal direction 21 of the cross section A-A, but are staggered in a step wise fashion (modification a), are straight and enclose an angle of approximately 45° inclined relative to the vertical axis 21 (modification c), or according to a mixed shape with a beveled step (modification b). The embodiment according to c) is a particularly preferred modification and provides an optimum magnetic flux.

List of Reference Numerals

	10	Drive assembly
	12	Drive motor
5	14	Field magnet
	16	Coil
	18	Armature
	20	Drive pin
	22	Bearing
10	24	Longitudinal axis
	26	Notches
	27	Center rib
	28	Core
	29	Vertical axis
15	30,a,b	Clip
	32,a	Plate
	34	Bolt
	36	Bolt arrangement
	38	Compression spring
20	40	Adjusting screw
	42	Clamp
	44	Pin, Oscillating spring (duplicate use)
	a	Center air gap section
25	b	Center air gap section
	A	Lateral air gap section
	B	Lateral air gap section